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intensive research to further decrease the package volume. I
the very important package techniques to arrange more than on
single package. In a multi-chip package, chips of processor,
dynamic random access memory (DRAM) and flash memory, and log
packed together in a single package to reduce the fabrication
packaging volume. Furthermore, the signal transmission path
enhance the efficiency. The multi-chip IC packaging technolo
applied to a multi-chip system with variable functions and op
frequencies, for example,

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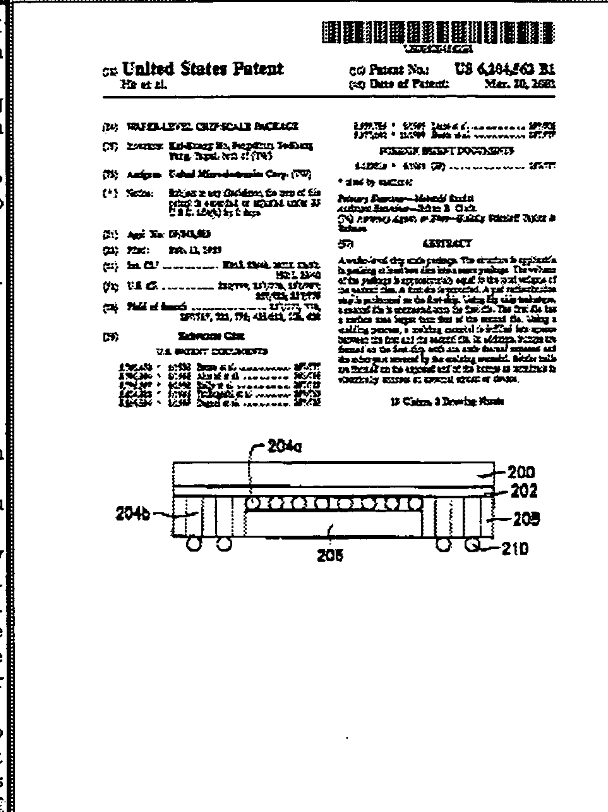
In FIG. 1, a conventional dual-chip module is shown. A su
comprising a copper pattern 12 is provided. By means of the
solder balls 14, the electrical connection to an external dev
established. A very popular material of the substrate is pol
with a larger size is adhered onto the substrate 10 with an i
as a glue layer in between. An insulating layer 20 and a die
size is then disposed on the insulating layer 16. Conductive
formed to electrically connect the dies 18, 22 and the substr
resin 26, the dies 18 and 22 and the substrate 10 are molded.
connection between the whole package and a printed circuit bo
achieved by ball grid array (BGA) which use solder balls 14 t
terminals on the printed circuit board. The drawback of this



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first to FIG. 3D, a completed chip-on-chip package 300 will b
As shown, the chip-on-chip package 300 includes a substrate
306, and a second die 316. The first die 306 is coupled to th
302 by a die attach material 308. The second die 316 is coupl
ate 302 by a first set of contacts 318a and 318b. The second
upled to the first die 306 by a second set of contacts 320. E
st set of contacts 318a and 318b. adhere to an associated one
conductive landings 314a and 314b on the substrate 302. Each
set of contacts 320 adhere to an associated one of a pluralit
12 on the first die 306.

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A through 3D will now be described concurrently with FIG. 2 to
the operations of FIG. 2. FIG. 3A illustrates a cross-sectio
st die 306 attached to the substrate 302 with the die attach m
ordance with one embodiment of the present invention.

ly, in operation 202 a substrate 302 is provided as shown in F
ate 302 may take any suitable form for distributing the signal
die 316 or the first die 306 to other components that are pos
the substrate or another external substrate or PCB. For examp
302 may be in the form of a ball grid array substrate, as show
er examples, the substrate may be in the form of a pin grid ar

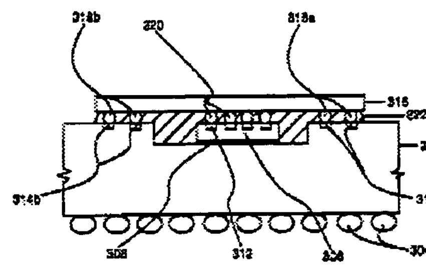
United States Patent [19] Patent Number: 6,084,308

Date of Patent: Jul. 4, 2000

CHIP-ON-CHIP INTEGRATED CIRCUIT PACKAGE AND METHOD FOR MAKING THE SAME

ABSTRACT

13 Claims, 6 Drawing Sheets



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ains bond pads 58. These bond pads 56 and 58 connect
r respective ICs 52 and 54. These bond pads may
active circuitry from one or more of the integrated
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vices in FIGS. 1-2. A further disadvantage is that
of FIG. 3 is not a vertically stacked
ire as are the devices of FIGS. 1-2. Due to this
-dimensional footprint of the device 16 of FIG. 3 is
e footprint of the devices illustrated in FIGS. 1 and
the device of FIG. 3, the overall surface of
uit boards which contain the device of FIG. 3 must be
to accommodate the MCM components.

ther manner in which the integrated circuit (IC)
integrate more functionality into a smaller physical
s a highly integrated chip (HIC) 18. In order to
in a smaller area, the integrated circuit industry is
any different types of structures, process steps, and
arge integrated circuit (IC) die. HIC devices may
types of IC modules into a mixed-technology device.
eoretical possibility of a digital signal processor
cessor 64, an analog to digital (A/D) converter 66,
ynamic random access memory (DRAM) 68, and

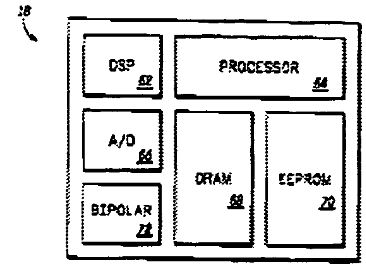

FIG. 4
-PRIOR ART-

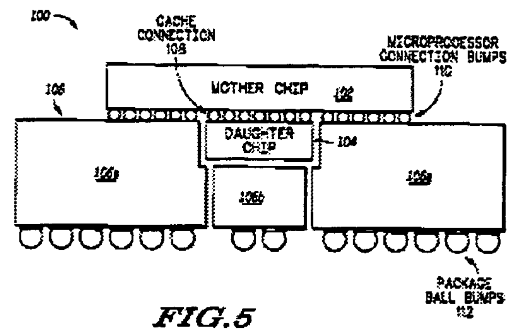

FIG. 5

EAST Browser - L2: (92) ("4742385"|"... | US 6084308 | Tag: S,T1 | Doc: 7/92 | "Full" 1/12 (Total images 12)

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19 Claims, 4 Drawing Figures

Exemplary Claim Number: 1

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(IC) packages. More particularly, the invention relates to packages that are assembled and mounted onto a substrate hav components that are coupled through the substrate with the c package.

2. Description of the Related Art

In the field of integrated circuits, chip-on-chip package within various electronic assemblies. The prominence of chi is due, in part, to the relatively high degree of functional chip-on-chip package. That is, two highly interdependent di together so that each die may quickly access information fro For example, an application specific integrated circuit (ASI access to a dedicated analog-to-digital (A/D) converter. Th A/D converter may be stacked and packaged together such that converter's input and output (I/O) pads are directly couplec pads. This stacked arrangement allows the ASIC to quickly u converter's capabilities and convert analog signals to digit reducing some of the problems associated with long intercon

Kelkar et al.

Date of Patent: Jul. 4, 2000

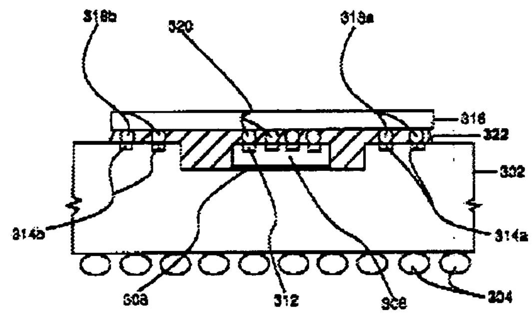
CHIP-ON-CHIP INTEGRATED CIRCUIT PACKAGE AND METHOD FOR MAKING THE SAME

FOREIGN PATENT DOCUMENTS

ABSTRACT

U.S. PATENT DOCUMENTS

19 Claims, 6 Drawing Sheets



optical communication systems. These advantages and others will become apparent from the following detailed description.

DRAWING DESCRIPTION:

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying Figures wherein like members bear like reference numerals and wherein:

[0039] FIGS. 1-4 depict optical communication systems of the present invention;

[0040] FIGS. 5-8(b) depicts waveband selectors of the present invention;

[0041] FIGS. 9-11 depict transient grating waveband selectors of the present invention; and,

[0042] FIGS. 12-13 depict multi-node optical communication networks of the present invention.

DETAILED DESCRIPTION:

DETAILED DESCRIPTION OF THE INVENTION

[0043] The operation of optical systems 10 of the present invention will be described generally with reference to the drawings for the purpose of illustrating embodiments only and not for purposes of limiting the same.

[0044] Generally, the optical system 10 includes at least one optical transmitter 12 and at least one optical receiver 14, as shown in FIG. 1. Each transmitter 12 is configured to transmit information via one or more information carrying wavelengths 18.sub.i,k contained in at least one waveband 16.sub.1,i to the receivers 14. Each receiver 14 is configured to receive the information carried via one or more of the information carrying wavelengths 18.sub.i,k. As used herein, the term "information" should be broadly construed to include any type of data, instructions, or signals that can be optically transmitted.

[0045] As shown in FIG. 1, the system 10 further includes at least one intermediate optical processing node 20, such as an optical switch 22. The transmitter 12 is configured to transmit an optical signal 24 containing one or more information carrying wavelengths 18; along signal transmission waveguide, i.e., fiber, 26 to the switch 22 via input port 28. The optical processing node 20 includes one or more waveband selectors, or selective element, 30 that are configured to pass and/or substantially prevent the passage of information in wavebands 16.sub.i to the receiver 14 via output ports 32. Because the information is being manipulated in wavebands, the individual information carrying wavelengths 18.sub.j within the waveband 16.sub.i do not have to be separated in individual wavelengths to be managed and processed. Also, the individual wavelengths 18.sub.j within the waveband 16.sub.i be varied in the system 10 without affecting the configuration of the optical processing node 20. Wavelengths 18.sub.j in the original signal 24 but not within the waveband 16.sub.i are prevented from passing through to the receivers 14.

[0046] In the present invention, optical signals 24 can be produced including a number of wavebands 16, each of which may contain one or more information carrying wavelengths in a continuous band of wavelengths or a plurality of wavelength bands. For example, a waveband 16 can be defined as having a continuous range of .about.200 GHz containing 20 different information carrying wavelengths 18.sub.1-20 spaced apart on a 10 GHz grid. The bandwidth of each waveband can be uniformly or variably sized depending upon the network capacity requirements. Likewise, the bandwidth of the waveband is not restricted, but can be varied to accommodate varying numbers of wavelengths.

Patent Application Publication May 30, 2002 Sheet 2 of 10 US 2002/0063929 A1

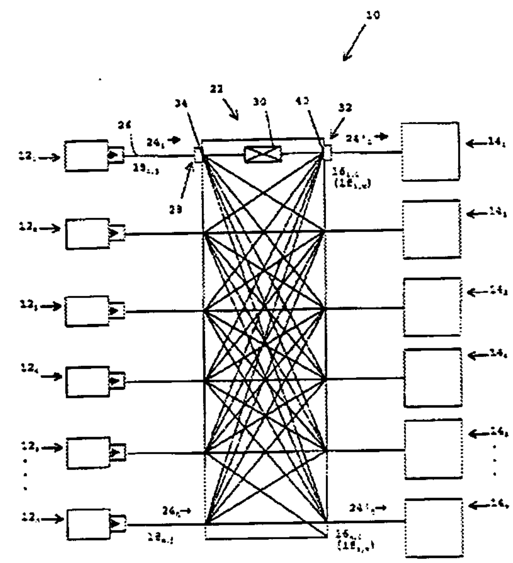


Fig. 2

[0027] Accordingly, there is a need for optical systems and optical components that allow for increased network capacity and flexibility. One aspect of which is to reduce the complexity of the equipment and increase the efficiency of the transmission system.

BRIEF SUMMARY OF THE INVENTION

[0028] The apparatuses and methods of the present invention address the above needs and concerns for improved optical switches and systems. An optical transmission system of the present invention includes one or more optical signal transmitters and optical signal receivers optically communicating via one or more intermediate optical processing nodes . Each optical transmitter includes one or more optical sources, such as modulated lasers, and is configured to transmit information via one or more information carrying wavelengths. Each optical receiver is configured to receive one or more of the information carrying wavelengths using one or more various detection techniques, such as direct detection using optical wavelength filters and photodiodes, or indirect detection using coherent detectors.

[0029] The intermediate optical processing nodes include optical switches, add and/or drop devices including at least one waveband selector configured to pass and substantially prevent the passage of optical wavebands that include a plurality of information carrying wavelengths from the transmitter to the receiver. The optical processing nodes provide for information management and processing in wavebands, instead of separating individual information carrying wavelengths from the signal and individually processing each wavelength. In this manner, high capacity processing of the information can be achieved without the prior complexities involved with increasing capacity. The processing of pluralities of individual wavelengths further provides for accommodating varying numbers and distributions of individual information carrying wavelengths in the system without having to reconfigure or replace system components.

[0030] In an embodiment of the present invention, the optical processing node includes a switch providing cross connections between a plurality of transmitters and receivers. Optical signals including one or more information carrying wavelengths are transmitted to optical switch input ports and are distributed to optical switch output ports by splitting and/or waveband demultiplexing the optical signals depending upon the type of waveband selector used in the switch.

[0031] Waveband selectors include at least one switch, gate, or filter, such as an erbium or mechanical switch, a Bragg grating, or a Mach-Zehnder or Fabry-Perot filter. The waveband selectors are generally configured to pass one or more optical wavebands from the input port to the output port in one mode and/or to substantially prevent the passage the optical wavebands in another mode. A signal is generally considered to be substantially prevented from passage, if the signal is sufficiently attenuated such that a remnant of the attenuated signal passing through the waveband selector does not destroy signals that have been selectively passed through the optical processing node. For example, a 40 dB attenuation of a signal will generally be sufficient to prevent cross-talk interference between remnant signals and signals passing through the optical processing node.

[0032] In an embodiment, each input signal is waveband demultiplexed to separate the input signal into waveband signals. Each waveband signal is then split and each split waveband signal passed through a switch to a respective output port. In an embodiment, an erbium doped fiber is used as the switch in the waveband selector to pass, as well as to controllably amplify or attenuate, the split waveband signal to the output port when supplied with optical pump power. In the absence of pump power, the erbium fiber absorbs the waveband signal, which substantially prevents the passage of the signal. One or more

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HUBER
(10) Pub. No.: US 2002/0063929 A1
(43) Pub. Date: May 30, 2002

(54) OPTICAL COMMUNICATION SYSTEM

(76) Inventor: DAVID R. HUBER, GLENWOOD, MD (US)

Correspondence Address:
CORVIS CORPORATION
INTELLECTUAL PROPERTY DEPARTMENT
7015 ALBERT EINSTEIN DRIVE
COLUMBIA, MD 210469400

(*) Notice: This is a publication of a continued prosecution application (CPA) filed under 37 CFR 1.53(d).

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(22) Filed: Jul. 21, 1998

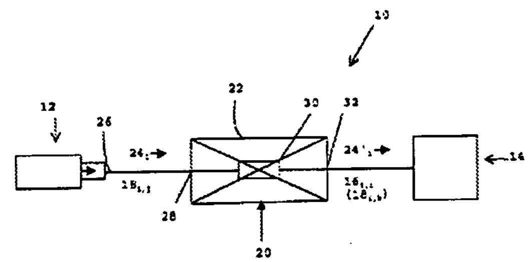
Publication Classification

(51) Int. Cl.[7] H04B 10/08; H04J 14/02; H04B 10/00

(52) U.S. Cl. 359/124; 359/110

(57) ABSTRACT

Apparatuses and methods are disclosed for use in optical communication systems. An optical system of the present invention includes an optical transmitter, an optical receiver, and an optical processing node optically connecting the transmitter and the receiver. The optical processing node includes at least one waveband selector configured to selectively pass at least one optical waveband of information including a plurality of information carrying wavelengths from the transmitter to the receiver. In an embodiment, the optical processing node includes a switch configured to separate an optical signal into optical wavebands of information and selectively pass the optical wavebands to the receiver without separating the plurality of information carrying wavelengths into individual wavelengths. In an embodiment of the optical transmission system, a plurality of nodes containing optical transmitters, receivers, and/or switching equipment are interconnected using optical processing nodes to form the network. The assignment of wavelengths to information and to destination can be performed at the client system interface with the optical network to provide for wavelength and waveband management without wavelength conversion.



to restore the transmission path.

[0005] Mentioned as a literature of an optical cross-connect system having such a failure-restoring function is "A Novel Optical Cross-connect System for Hitless Optical Network Reconfiguration", a presentation No. SB-8-1 at an autumn general conference held in 1993 under Institute of Electronics, Information and Communication Engineers. Proposed and studied in the report are a 64.times.64 switch matrix and an optical cross-connect system using it. The 64.times.64 switch matrix is constituted by employing a 8.times.8 switch matrix as the building block thereof and connecting the 8.times.8 switch matrices in a three-stage link connection manner. As shown in this embodiment, in related-art optical cross-connect systems, a general method for embodying the high-capacity was as follows: A strictly non-blocking switch matrix is employed as the fundamental building block and then performing a link connection of the matrices, thereby embodying the high-capacity. Here, the switch matrix means a switch configuration in such a broader meaning as to make it possible to switch and connect a plurality of inputs and a plurality of outputs, and includes configurations such as a tree type switch configuration.

[0006] As shown in FIG. 1, the optical cross-connect system 2 is provided at each node on a network and has a function of changing a connection between a line terminal 1 and a transmission path, i.e., the optical fiber 3 or the optical fiber 4. Illustrated in FIG. 2 is a basic system configuration of an optical cross-connect system in the case where M units of line terminals within a node are connected with an optical switch unit 11 through 2M units of optical fibers 13, and the number of working optical fibers 14 and that of protecting optical fibers 15 are set to be 2M and 2R, respectively. A monitor unit 12 detects failures in the fibers, and the optical switch unit 11, which a control unit 10 controls, performs switching of connections. Optical signals are launched into or out of the optical switch unit 11, i.e., a main unit in the optical cross-connect system, from both the line terminal side and the transmission path side. When organizing the optical signals in accordance with the directions thereof, it has been found that the result is summarized as an optical switch matrix 18. The optical switch matrix 18, as shown in FIG. 2B, is a square matrix having 2M+R units of input ports and 2M+R units of output ports, i.e., a switch matrix in which the number of inputs is equal to that of outputs.

[0007] Generally speaking, the optical fibers 14 or the optical fibers 15 are installed as a cable produced by bundling about 24 to 47 units of the optical fibers in total, and connected with each node are cables originating from a plurality of neighboring nodes . Accordingly, the number of the optical fibers for each node extends to a scale of 200 to 300. This requires that the optical cross-connect system, which operates with these optical fibers, also have a high capacity corresponding thereto. The biggest problem in embodying such a high-capacity optical cross-connect system lies in making the optical switch unit 11, i.e. the main unit in the optical cross-connect system, into a large scale switch matrix.

[0008] Combination of a plurality of optical switch devices makes it possible to embody such a large scale switch matrix. It is desirable that scale of each optical switch device itself is large, i.e., the degree of integration thereof is high. The degree of integration of an optical device, however, is generally so much lower compared with that of an electronic device. For example, as described in the related art, it is close to a limit of the present-day technology to integrate the 8.times.8 switch matrices on a single chip. Also, structures of optical switch devices employed in currently embodied integrated type switch devices (such as 4.times.4, and 8.times.8) are generally inferior to those of single-type switch devices (such as 1.times.2, and 2.times.2) in the fundamental characteristics such as isolation at the time of switching and the insertion loss. This inevitably gives rise to a deterioration in the optical signal quality at the time of switching, thus making it difficult to apply to the high-speed signal the large scale switch matrix which is embodied

FIG.2A

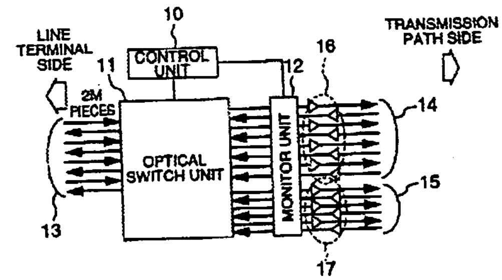
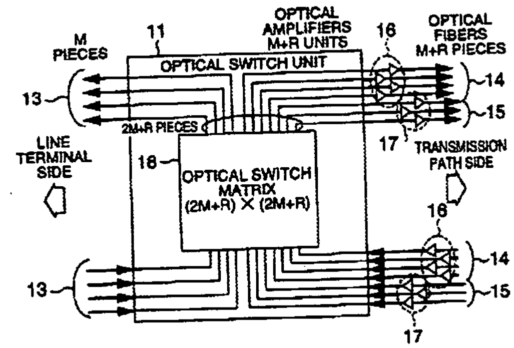


FIG.2B



PGPUB-DOCUMENT-NUMBER: 20010009465
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20010009465 A1

TITLE: WDM optical transmission system

PUBLICATION-DATE: July 26, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Uehara, Daisuke	Tokyo		JP	

APPL-NO: 09/813877

DATE FILED: March 22, 2001

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	DOC-ID	APPL-DATE
JP	124770/1997	1997JP-124770/1997	April 30, 1997

INT-CL: [07], H04J014/02
US-CL-PUBLISHED: 359/124, 359/128
US-CL-CURRENT: 359/124, 359/128

ABSTRACT:

Disclosed is a wavelength division multiplexing optical transmission system which has: a wavelength-demultiplexing means for receiving a wavelength-multiplexed signal that a monitor-signal wavelength component is multiplexed to a plurality of main-signal wavelength components and demultiplexing the wavelength multiplexed signal into wavelength components; an optical switch for receiving the main-signal wavelength components demultiplexed by the wavelength-demultiplexing means and switching into either one of routes to output directly and to output through a bit-rate-selective type regenerator for each of the main-signal wavelength components;

the bit-rate-selective type regenerator for conducting the regenerative repeating to a signal input through the optical switch according to the bit rate and then returning it to the optical switch ; a monitor signal receiver for receiving and terminating the monitor-signal wavelength component demultiplexed by the wavelength-demultiplexing means; a controller for detecting the bit rate and pass-through node number of each of the main-signal wavelength components by receiving a signal from the monitor signal receiver, generating a control signal to control the switching of the optical switch and the regenerative repeating of the bit-rate-selective type regenerator, and rewriting information to show the bit rate, pass-through node number and execution/non-execution of regenerative repeating of each of the main-signal wavelength components to be output to the next-stage node ; a monitor signal transmitter for receiving the information rewritten by the controller and generating a monitor-signal wavelength component; and a wavelength-multiplexing means for multiplexing the main-signal wavelength components output from the optical switch and the monitor-signal wavelength component output from the monitor signal transmitter.

BRIEF SUMMARY:

FIELD OF THE INVENTION

[0001] This invention relates to a WDM optical transmission system, and more particularly to, a WDM optical transmission system provided with means for monitoring and controlling wavelength components at each node.

BACKGROUND OF THE INVENTION

US 20010009465A1

(19) United States
(12) Patent Application Publication (10) Pub. No.: US 2001/0009465 A1
Uehara (43) Pub. Date: Jul. 26, 2001

(54) WDM OPTICAL TRANSMISSION SYSTEM

(76) Inventor: Daisuke Uehara, Tokyo (JP)

Correspondence Address:
McGuireWoods LLP
Suite 1800
1750 Tysons Boulevard
McLean, VA 22102 (US)

(21) Appl. No.: 09/813,877

(22) Filed: Mar. 22, 2001

Related U.S. Application Data

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(30) Foreign Application Priority Data

Apr. 30, 1997 (JP) 124770/1997

Publication Classification

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(52) U.S. Cl. 359/124; 359/128

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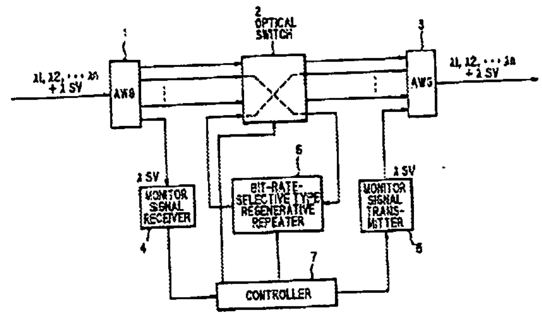
the bit-rate-selective type regenerator for conducting the regenerative repeating to a signal input through the optical switch according to the bit rate and then returning it to the optical switch; a monitor signal receiver for receiving and terminating the monitor-signal wavelength component demultiplexed by the wavelength-demultiplexing means; a controller for detecting the bit rate and pass-through node number of each of the main-signal wavelength components by receiving a signal from the monitor signal receiver, generating a control signal to control the switching of the optical switch and the regenerative repeating of the bit-rate-selective type regenerator, and rewriting information to show the bit rate, pass-through node number and execution/non-execution of regenerative repeating of each of the main-signal wavelength components to be output to the next-stage node; a monitor signal transmitter for receiving the information rewritten by the controller and generating a monitor-signal wavelength component; and a wavelength-multiplexing means for multiplexing the main-signal wavelength components output from the optical switch and the monitor-signal wavelength component output from the monitor signal transmitter.



repeating was conducted at the node concerned into the wavelength component subject to the regenerative repeating, further writing the pass-through node number to show that the other wavelength components pass through the node concerned into the other wavelength components, then outputting them to the monitor signal transmitter 5. The monitor signal transmitter 5 generates the monitor-signal wavelength component (.lambda..sub.sv) according to the output signal from the controller 7, outputting it to AWG 3. AWG 3 multiplexes the main-signal wavelength components (.lambda..sub.1 to .lambda..sub.n) from the optical switch 2 and the monitor-signal wavelength component (.lambda..sub.sv) from the monitor signal transmitter 5, outputting it to the next-stage node .

[0071] An optical cross connect type WDM optical transmission system in the second preferred embodiment will be explained in FIG. 8.

[0072] As shown in FIG. 8, a WDM end station 54 comprises a WDM light transmitter 55 to transmit a main-signal wavelength component, a to monitor signal transmitter 57 to generate a monitor signal to carry the bit-rate information of wavelength components (.lambda..sub.1 to .lambda..sub.n), and an optical coupler 48 to multiplex the main-signal wavelength component and the monitor-signal wavelength component. The signal from the WDM end station 54 is transmitted through nodes 58 to 65 while switching arbitrarily the route of each wavelength component. At each node, the separation/insertion of the monitor-signal wavelength component is conducted so that the monitor signal can be always sent to the downstream node.

[0073] FIG. 3 shows the details of each node in this system. A WDM optical signal to be input is wavelength-demultiplexed by AWGs 8-1 to 8-n, then the main-signal wavelength components (.lambda..sub.1 to .lambda..sub.n) are output to optical switches 9-1 to 9-n and the monitor-signal wavelength component (.lambda..sub.sv) is output to a monitor signal receiver 11. The monitor signal receiver 11 terminates information as to the bit rates of the main-signal wavelength components (.lambda..sub.1 to .lambda..sub.n), pass-through node number, execution of regenerative repeating etc., then outputting it to a controller 14. The controller 14 detects a wavelength component to need the regenerative repeating and its bit rate based upon the information from the monitor signal receiver 11, and outputs a control signal to the optical switches 9-1 to 9-n and bit-rate-selective type regenerators 13-1 to 13-n.

[0074] The optical switches 9-1 to 9-n switch the route of the wavelength component to conduct the regenerative repeating into the side of the bit-rate-selective regenerators 13-1 to 13-n according to the control signal from the controller 14. The other wavelength components not to need the regenerative repeating are output while being switched into arbitrary output ports. The bit-rate-selective regenerators 13-1 to 13-n receive the wavelength component signals switched by the optical switches 9-1 to 9-n, conducting the regenerative repeating according to the bit rate based upon the control signal from the controller 14, then returning the signals to the optical switches 9-1 to 9-n, outputting the signals with the other wavelength component signals to AWGs 10-1 to 10-n.

[0075] Also, the controller 14 writes information to show that the regenerative repeating was conducted at the node concerned into the wavelength component subject to the regenerative repeating, further writing the pass-through node number to show that the other wavelength components pass through the node concerned into the other wavelength components, then outputting them to the monitor signal transmitter 12. The monitor signal transmitter 12 generates the monitor-signal wavelength component (.lambda..sub.sv) according to the output signal from the controller 14, outputting it to AWGs 10-1 to 10-n. AWGs 10-1 to 10-n multiplex the main-signal wavelength components .lambda..sub.1 to .lambda..sub.n) from the optical switches 9-1 to 9-n and the monitor-signal wavelength component (.lambda..sub.sv) from the monitor signal transmitter 12, outputting it to the next-stage node .

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(19) United States
(12) Patent Application Publication
Uehara
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(76) Inventor: Daisuke Uehara, Tokyo (JP)

Correspondence Address:
McGuireWoods LLP
Suite 1800
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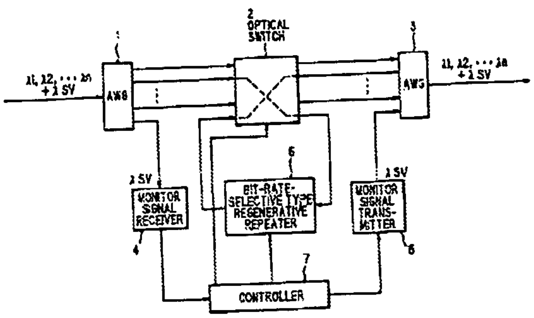
(52) U.S. Cl. 359/124; 359/128

(57) ABSTRACT

Disclosed is a wavelength division multiplexing optical transmission system which has: a wavelength-demultiplexing means for receiving a wavelength-multiplexed signal that a monitor-signal wavelength component is multiplexed to a plurality of main-signal wavelength components and demultiplexing the wavelength multiplexed signal into wavelength components; an optical switch for receiving the main-signal wavelength components demultiplexed by the wavelength-demultiplexing means and switching into either one of routes to output directly and to output through a bit-rate-selective type regenerator for each of the main-signal wavelength components;

the bit-rate-selective type regenerator for conducting the regenerative repeating to a signal input through the optical switch according to the bit rate and then returning it to the optical switch; a monitor signal receiver for receiving and terminating the monitor-signal wavelength component demultiplexed by the wavelength-demultiplexing means; a controller for detecting the bit rate and pass-through node number of each of the main-signal wavelength components by receiving a signal from the monitor signal receiver, generating a control signal to control the switching of the optical switch and the regenerative repeating of the bit-rate-selective type regenerator, and rewriting information to show the bit rate, pass-through node number and execution/non-execution of regenerative repeating of each of the main-signal wavelength components to be output to the next-stage node; a monitor signal transmitter for receiving the information rewritten by the controller and generating a monitor-signal wavelength component; and a wavelength-multiplexing means for multiplexing the main-signal wavelength components output from the optical switch and the monitor-signal wavelength component output from the monitor signal transmitter.



main-signal wavelength components (.lambda..sub.1 to .lambda..sub.n) in the WDM optical signal input, outputting information as to the measured S/N ratios to a controller 29. The controller 29 detects a wavelength component with a S/N ratio less than a threshold value base upon the signal from the S/N monitor circuit 27, judging that the wavelength component has the deteriorated S/N ratio and therefore it needs to be subject to the regenerative repeating, then outputting a control signal to conduct the regenerative repeating to the optical switch 24.

[0083] The optical switch 24 switches the route of the wavelength component to conduct the regenerative repeating into the side of a bit-rate-selective regenerator 28 according to the control signal from the controller 29. The other wavelength components not to need the regenerative repeating are output as they are. The bit-rate-selective regenerator 28 receives the wavelength component signal switched by the optical switch 24, conducting the regenerative repeating while detecting the bit rate of the received signal. Then, the wavelength component subject to the regenerative repeating is returned to the optical switch 24, then output with the other wavelength component not subject to the regenerative repeating to AWG 25. Then, AWG 25 multiplexes the main-signal wavelength components output from the optical switch 24, outputting it to the next-stage node .

[0084] A WDM optical transmission system in the fifth preferred embodiment will be explained will be explained in FIG. 6. In FIG. 6, a node applicable to point-to-point system, optical cross connect system, optical ADM ring system etc. in the fifth embodiment is shown. As shown in FIG. 6, a WDM optical signal is received by the node, input to AWG 30, demultiplexed. Then, the demultiplexed wavelength components are divided by optical dividers 33-1 to 33-n, thereby one is output to an optical switch 31 and the other is output to a S/N monitor circuit 34.

[0085] The S/N monitor circuit 34 measures separately the ratio of signal level to spontaneous emission light (ASE) for each of the main-signal wavelength components (.lambda..sub.1 to .lambda..sub.n), outputting it to a controller 36. The controller 36 compares each of the signals from the S/N monitor circuit 34 with a threshold value, and, to a wavelength component with a S/N ratio less than a threshold value, judging that the wavelength component has the deteriorated S/N ratio and therefore it needs to be subject to the regenerative repeating, then outputting a control signal to conduct the regenerative repeating to the optical switch 31.

[0086] The optical switch 31 switches the route of the wavelength component to conduct the regenerative repeating into the side of a bit-rate-selective regenerator 35 according to the control signal from the controller 36. The other wavelength components not to need the regenerative repeating are output as they are. The bit-rate-selective regenerator 35 receives the wavelength component signal switched by the optical switch 31, conducting the regenerative repeating while detecting the bit rate of the received signal. Then, the wavelength component subject to the regenerative repeating is returned to the optical switch 31, then output with the other wavelength component not subject to the regenerative repeating to AWG 32. Then, AWG 32 multiplexes the main-signal wavelength components output from the optical switch 31, outputting it to the next-stage node .

[0087] Although the invention has been described with respect to specific embodiment for complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modification and alternative constructions that may be occurred to one skilled in the art which fairly fall within the basic teaching here is set forth.
[CLMH]

What is claimed is:

US 20010009465A1

(19) United States
(12) Patent Application Publication (10) Pub. No.: US 2001/0009465 A1
(43) Pub. Date: Jul. 26, 2001

Uehara

(54) WDM OPTICAL TRANSMISSION SYSTEM

(76) Inventor: Daisuke Uehara, Tokyo (JP)

Correspondence Address:
McGuire Woods LLP
Suite 1900
1750 Tysons Boulevard
McLean, VA 22102 (US)

(21) Appl. No.: 09/813,877

(22) Filed: Mar. 23, 2001

Related U.S. Application Data

(62) Division of application No. 09/066,576, filed on Apr. 28, 1998.

(30) Foreign Application Priority Data

Apr. 30, 1997 (JP) 124770/1997

Publication Classification

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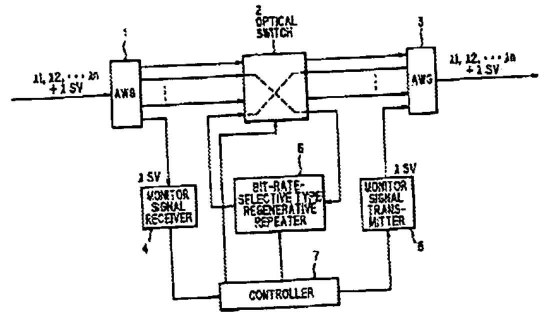
(52) U.S. Cl. 359/124; 359/128

(57) ABSTRACT

Disclosed is a wavelength division multiplexing optical transmission system which has a wavelength-demultiplexing means for receiving a wavelength-multiplexed signal that a monitor-signal wavelength component is multiplexed to a plurality of main-signal wavelength components and demultiplexing the wavelength multiplexed signal into wavelength components; an optical switch for receiving the main-signal wavelength components demultiplexed by the wavelength-demultiplexing means and switching into either one of routes to output directly and to output through a bit-rate-selective type regenerator for each of the main-signal wavelength components;

the bit-rate-selective type regenerator for conducting the regenerative repeating to a signal input through the optical switch according to the bit rate and then returning it to the optical switch; a monitor signal receiver for receiving and terminating the monitor-signal wavelength component demultiplexed by the wavelength-demultiplexing means; a controller for detecting the bit rate and pass-through node number of each of the main-signal wavelength components by receiving a signal from the monitor signal receiver, generating a control signal to control the switching of the optical switch and the regenerative repeating of the bit-rate-selective type regenerator, and rewriting information to show the bit rate, pass-through node number and execution/non-execution of regenerative repeating of each of the main-signal wavelength components to be output to the next-stage node; a monitor signal transmitter for receiving the information rewritten by the controller and generating a monitor-signal wavelength component; and a wavelength-multiplexing means for multiplexing the main-signal wavelength components output from the optical switch and the monitor-signal wavelength component output from the monitor signal transmitter.



US-PAT-NO:
DOCUMENT-IDENTIFIER: US 6285475 B1

TITLE:

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	RULE 47
	Plano	TX	N/A	N/A	

ASSIGNEE INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE COI
	Washington	DC	N/A	N/A	02

INT-CL: [[CIED]] H04B010/08

US-CL-ISSUED: 359/110,359/117
US-CL-CURRENT: 359/110,359/117

REF-CITED:

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4527270	July 1985	Sweeton	371/
4542502	September 1985	Levinson et al.	370/
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U.S. Patent Sep. 4, 2001 Sheet 1 of 11 US 6,285,475 B1

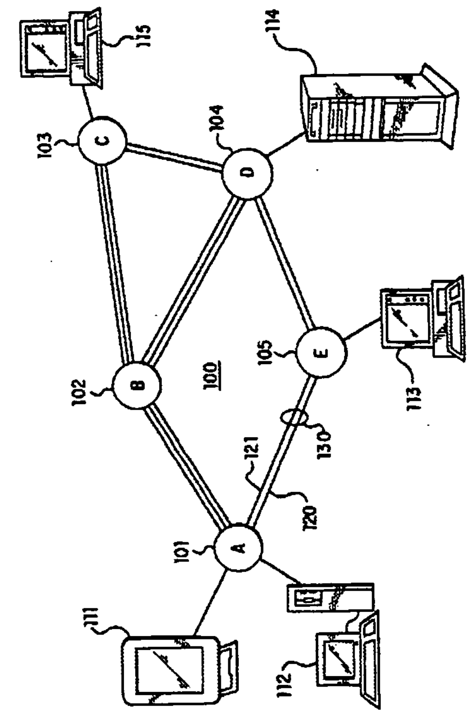

FIG. 1

EAST Browser - L283 (511) optic$4 adj... | US 5999287 A | Tag: S,T1 | Doc: 177/511 | "Full" 2/11 | Total images 11

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US-PAT-NO:
DOCUMENT-IDENTIFIER: US 5999287 A

TITLE:

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	RULE 47
	GT Finborough	N/A	N/A	GB	
	Ipswich	N/A	N/A	GB	

ASSIGNEE INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE COI
	London	N/A	N/A	GB	03

FOREIGN-APPL-PRIORITY-DATA:
FOREIGN-PRIORITY:
FOREIGN-PRIORITY-APPL-NO: EP 94309761
FOREIGN-PRIORITY-APPL-DATE: December 23, 1994

INT-CL: [[CIED]] H04B010/20,H04J014/08 ,H04J010/00

US-CL-ISSUED: 359/118,359/119 ,359/136 ,359/135 ,359/139 ,359/158 ,359/138
US-CL-CURRENT: 359/118,359/119 ,359/135 ,359/136 ,359/138 ,359/139 ,359/158

REF-CITED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
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5479291	December 1995	Smith	359/
5493433	February 1996	Pruncal	359/
5497386	March 1996	Fontana	372/
5548433	August 1996	Smith	359/
5742415	April 1998	Manning	359/
5900956	May 1999	Cotter	359/

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COUNTRY	FOREIGN-PAT-NO	PUBN-DATE	US-CL
WO	WO A 91 14963	October 1991	
WO	WO A 93 22855	November 1993	

ART-UNIT: 273

20 Claims, 9 Drawing figures
Exemplary Claim Number: 1
Number of Drawing Sheets: 5

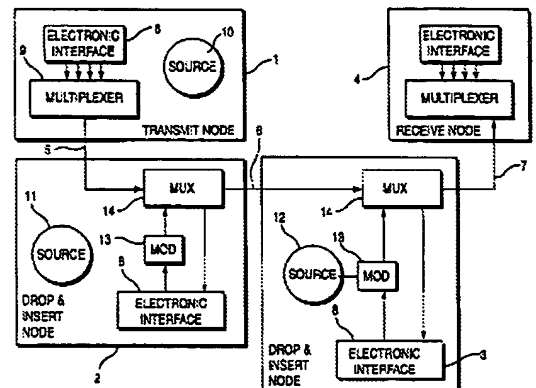

Fig. 1

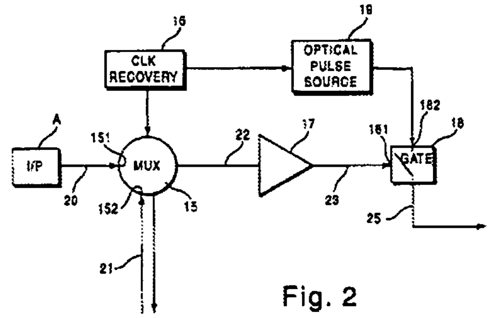

Fig. 2

CLIPPEDIMAGE= JP409329815A
PAT-NO: JP409329815A
DOCUMENT-IDENTIFIER: JP 09329815 A
TITLE: WAVELENGTH SELECTING NODE

PUBN-DATE: December 22, 1997

INVENTOR-INFORMATION:
NAME
OKAYAMA, HIDEAKI

ASSIGNEE-INFORMATION:

NAME	COUNTRY
OKI ELECTRIC IND CO LTD	N/A

APPL-NO: JP09017126
APPL-DATE: January 30, 1997

INT-CL_(IPC): G02F001/313; G02B006/293 ; H04B010/02

ABSTRACT:
PROBLEM TO BE SOLVED: To enable switching the wavelength of light to be selected at a high speed.

SOLUTION: The wavelength selecting node is provided with 1st and 2nd optical circulators 10 and 12, and respective optical circulators 10 and 12 are individually provided with three ports. Between the light circulators 10 and 12, a wavelength selecting means 26 is installed. And the wavelength selecting means 26 is constituted of a 2×2 matrix optical switch 28 and a fiber grating 30. The 2×2 matrix optical switch 28 is provided with four port X1, X2, Y1 and Y2, the port X1 is connected to the 1st input/output port 18 of the 1st optical circulator 10 by an optical fiber 40. In the same way, the port Y1 is connected to the 2nd input/output port 24 of the 2nd optical circulator 12 by an optical fiber 42. Besides, one end of the fiber grating 30 is connected to the port X2, the other end of the fiber grating 30 is connected to the port Y2, the port X2 is connected to the port Y2 by the fiber grating 30.

(19)日本国特許庁（JP） (12)公開特許公報(A) (11)特許出願公開番号
特開平9−329815
(43)公開日 平成9年(1997)12月22日

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G02F 1/313			G02F 1/313		
G02B 6/293			G02B 6/28	B	
H04B 10/02			H04B 9/00	U	

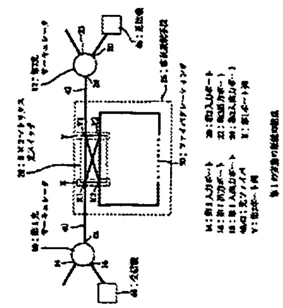
審査請求 未請求 請求項の数6 OL (全17頁)

(21)出願番号 特願平9−17126
(22)出願日 平成9年(1997)1月30日
(31)優先権主張番号 特願平8−91422
(32)優先日 平8(1996)4月12日
(33)優先権主張国 日本(JP)

(71)出願人 000000295
沖電気工業株式会社
東京都港区虎ノ門1丁目7番12号
(72)発明者 岡山 秀彰
東京都港区虎ノ門1丁目7番12号 沖電気工業株式会社内
(74)代理人 弁理士 大垣 孝

(54)【発明の名称】 波長選択ノード

(57)【要約】
【課題】 選択する光の波長を高速で切り替える波長選択ノード。
【解決手段】 第1および第2光サーキュレータ10および12を具えており、各光サーキュレータ10および12は、それぞれ3つのポートを具えている。各光サーキュレータ10および12間には波長選択手段26が設けられている。そして、波長選択手段26は2×2マトリクス光スイッチ28とファイバグレーティング30とから構成されている。2×2マトリクス光スイッチ28は4つのポートX1、X2、Y1およびY2を具えており、ポートX1は第1光サーキュレータ10の第1入出力ポート18に光ファイバ40で以て接続されており、同様に、ポートY1も第2光サーキュレータ12の第2入出力ポート24に光ファイバ42で以て接続されている。また、ポートX2にファイバグレーティング30の一方の端が接続されており、ポートY2にファイバグレーティング30の他方の端が接続されており、ポートX2およびポートY2間がファイバグレーティング30により接続されている。



CLIPPEDIMAGE= JP409133836A
PAT-NO: JP409133836A
DOCUMENT-IDENTIFIER: JP 09133836 A
TITLE: COUPLING DEVICE FOR COUPLING OPTICAL CONNECTION PART

PUBN-DATE: May 20, 1997

INVENTOR-INFORMATION:
NAME
DEVENTER, MATTYS OSKAR VAN

ASSIGNEE-INFORMATION:

NAME	COUNTRY
KONINKL PTT NEDERLAND NV	N/A

APPL-NO: JP08275642
APPL-DATE: October 18, 1996

INT-CL_(IPC): G02B006/28; G02B006/24

ABSTRACT:
PROBLEM TO BE SOLVED: To actualize a distribution network although only unidirectional amplification is applied and to provide the coupling device with self-restorable property based upon several network nodes which have coupling devices and are included in a single fiber connection part.

SOLUTION: In the ring-shaped optical distribution network equipped with a center node and N network nodes, a distributed signal DS is sent by the center node in two transmission directions (F and B). To carry out a drop continue function (DC function), each network node consists of a coupling device 21 equipped with an optical switch 28 with 2×2 terminals and a tapping device 33. The switch and tapping device are mutually coupled by a method which switches the DC function to only one of the two transmission direction. The switch 28 is switched when the distributed signal is not received by the network node any more. This network has self-restorable property against a single fault of the network.

(19)日本国特許庁（JP） (12)公開特許公報（A） (11)特許出願公開番号

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G02B 6/28			G02B 6/28 Z	
6/24			6/24	

審査請求 有 請求項の数9 OL （全7頁）

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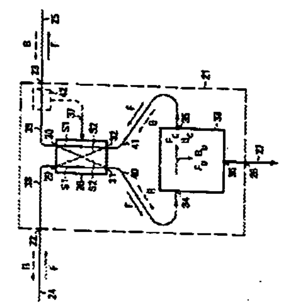
(22)出願日 平成8年(1996)10月18日
(31)優先権主張番号 1001441
(32)優先日 1995年10月18日
(33)優先権主張国 オランダ（NL）

(71)出願人 591104518
コニンクリジケ ピーティーティー ネーダーランドエヌ ヴィー
KONINKLIJKE PTT NEDERLAND NEAMLOZE VENNOOTSHAP
オランダ国 9726 エイシー グローニゲン ステーションズウエー 10
(72)発明者 ヴァン デベンテル マチジス オスカー
オランダ国 2283 エイチビー リーヂシエンダム プリンス フレデリクラーン 475
(74)代理人 弁理士 斉藤 武彦

(54)【発明の名称】 光波接続部を結合させるための結合装置

(57)【要約】
【課題】 単一方向の増幅のみが使用されるにもかかわらず分配ネットワークが実現でき、結合装置を有して単一ファイバー接続部に含まれる幾つかのネットワークノードに基づく、自己修復性のある結合装置を提供する。
【解決手段】 中心ノードとN個のネットワークノードを備えたリング状光分配ネットワークにおいて、分配信号DSが中心ノードによって2つの送信方向（F，B）に送信される。ドロップコンティニュー機能（DC機能）を遂行するために、各ネットワークノードは2×2の端子をもつ光スイッチ（28）とタッピングデバイス（33）を備えた結合装置（21）からなっている。このスイッチとタッピングデバイスは同時にDC機能が2つの送信方向の1つにだけスイッチするような方法で相互に結合しているスイッチ（28）は、分配信号がネットワークノードにおいてもはや受信されなくなった時、切り換えられる。このようなネットワークは単一のネットワークの故障に対して自己修復性がある。



CLIPPEDIMAGE= EP000859484A2
PUB-NO: EP000859484A2
DOCUMENT-IDENTIFIER: EP 859484 A2
TITLE: Fault restoration control method and it's apparatus in a communication network

PUBN-DATE: August 19, 1998

INVENTOR-INFORMATION:

NAME	COUNTRY
SAWADA, YASUSHI	JP
TSUSHIMA, HIDEAKI	JP
KITAJIMA, SHIGEKI	JP
KANETAKE, TATSUO	JP

ASSIGNEE-INFORMATION:

NAME	COUNTRY
HITACHI LTD	JP

APPL-NO: EP98102421
APPL-DATE: February 12, 1998

PRIORITY-DATA: JP03377997A (February 18, 1997)
INT-CL_(IPC): H04J003/14; H04J003/08 ; H04Q011/04 ; H04Q011/00
EUR-CL (EPC): H04B010/00; H04J014/02, H04Q003/00

ABSTRACT:
CHG DATE=19990617 STATUS=O> A method for restoration from a fault in a communication network formed by interconnecting a plurality of nodes (N1, N2, N3) including at least one set of node equipment each including a line terminal equipment (LTE1) and an optical cross-connect equipment (OXC1), via a plurality of transmission lines using optical fibers (OF12, OF13, OF23). According to this method for restoration from a fault, if a line terminal equipment (LTE1) of at least one set of node equipment has detected a fault in an optical fiber (OF12) under communication, it gives (301) a command functioning as trigger for optical fiber change-over to an optical cross-connect equipment (OXC1) included in the node equipment (N1). Upon receiving this command functioning as the trigger, the optical cross-connect equipment (OXC1) exchanges (302, 303, 304, 305) change-over control information indicating optical switch setting situation between it and an optical cross-connect equipment included in another node equipment, and forms (309, 310, 311) a restoration route. <IMAGE>

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(11) EP 0 859 484 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
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(51) Int Cl.6: H04J 3/14, H04J 3/08, H04Q 11/04, H04Q 11/00

(21) Application number: 98102421.9

(22) Date of filing: 12.02.1998

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Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 18.02.1997 JP 3377997

(71) Applicant: Hitachi, Ltd.
Chiyoda-ku, Tokyo 101-0062 (JP)

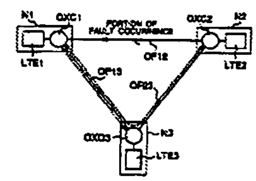
(72) Inventors:
- Sawada, Yasushi
Yokohama-shi (JP)
- Tsushima, Hideaki
Wako-shi (JP)
- Kitajima, Shigeki
Kawasaki-shi (JP)
- Kanetake, Tatsuo
Kawasaki-shi (JP)

(74) Representative:
Altenburg, Udo, Dipl.-Phys. et al
Patent- und Rechtsanwälte,
Bardehle . Pagenberg . Dost . Altenburg .
Frohwitter . Geissler & Partner,
Galileiplatz 1
81679 München (DE)

(54) Fault restoration control method and it's apparatus in a communication network

(57) A method for restoration from a fault in a communication network formed by interconnecting a plurality of nodes (N1, N2, N3) including at least one set of node equipment each including a line terminal equipment (LTE1) and an optical cross-connect equipment (OXC1), via a plurality of transmission lines using optical fibers (OF12, OF13, OF23). According to this method for restoration from a fault, if a line terminal equipment (LTE1) of at least one set of node equipment has detected a fault in an optical fiber (OF12) under communication, it gives (301) a command functioning as trigger for optical fiber change-over to an optical cross-connect equipment (OXC1) included in the node equipment (N1). Upon receiving this command functioning as the trigger, the optical cross-connect equipment (OXC1) exchanges (302, 303, 304, 305) change-over control information indicating optical switch setting situation between it and an optical cross-connect equipment included in another node equipment, and forms (309, 310, 311) a restoration route.

FIG. 1



EP 0 859 484 A2